



Case report

Right hepatic trisectionectomy combined total caudate lobectomy with non-touch technique for advanced hilar cholangiocarcinoma: A surgical case report (with video)

Thanh Khiem Nguyen^{a,1}, Ham Hoi Nguyen^{a,1}, Tuan Hiep Luong^{b,*}, Van Khang Le^c, Kim Khue Dang^a, Van Duy Le^a

^a Department of Gastrointestinal and Hepato-pancreato-biliary surgery, Bach Mai Hospital, Hanoi, Viet Nam

^b Department of Surgery, Hanoi Medical University, Viet Nam

^c Department of Diagnostic and Interventional Radiology, Bach Mai Hospital, Hanoi, Viet Nam

ARTICLE INFO

Keywords:

Hilar cholangiocarcinoma
Right Trisectionectomy
Total caudate lobectomy
Non-touch technique
Case report

ABSTRACT

Background: Extended resection such as right trisectionectomy combined with total caudate lobectomy with non-touch technique for advanced hilar cholangiocarcinoma (CCA) is still challenging for all Hepato-pancreato-biliary surgeons.

Presentation: A 45-year-old female with advanced hilar CCA involved the right intrahepatic bile ducts in continuity with the left medial sectional bile duct without PV invasion had undergone right trisectionectomy combined with total caudate lobectomy with non-touch technique. Dissection of the hepatic peduncle by Lorta-Jacob Procedure, ligation, and resection of the right hepatic artery (RHA) and the right portal vein (PV), before that determine whether portal bifurcation's tumor infiltration or not. Mobilization of the right liver lobe, ligate all the short hepatic veins from the caudal to cranial direction, as well as the right hepatic vein (RHV) and the middle hepatic vein (MHV). Complete caudate lobectomy with right-left approach. Determine hepatic parenchyma cut, left cholangiostomy to the division of the subsegments 2,3, stitch formation of the subsegments 2,3 bile duct. Determine negative upper section of the biliary tract. The operative time was 432 min, and the blood loss was 750 ml. Postoperative recovery was uneventful without any major complications but developed intra-abdominal abscess that required percutaneous drainage.

Discussion: Extended resection procedures such as extend right/left trisectionectomy, hepato-pancreaticoduodenectomy (HPD) and/or combined vascular resection are only curative treatment for advanced hilar CCA. There hadn't been any reported cases describing step-by-step right trisectionectomy combined with total caudate lobectomy with non-touch technique with clear illustrations and videos yet.

Conclusion: Careful preparation with preoperative biliary drainage as well as precise evaluation of the functional capacity of the future liver remnant, as well as meticulous experience of surgeons in hepatic anatomy and non-touch resection technique are key points for success in extended resection for advanced hilar CCA.

1. Background

Biliary malignancy, or Cholangiocarcinoma (CCA) is a type of malignancy that arises from any portion of the biliary epithelium, which is classified to intra-hepatic or extra-hepatic CCA and accounts for 3% of gastrointestinal cancers [1,2]. Extra-hepatic cholangiocarcinoma (ECC) including Hilar cholangiocarcinoma (Klatskin's tumor) and distal cholangiocarcinoma. Extrahepatic cholangiocarcinoma of the middle third

of the common bile duct is rare, often invasion from gallbladder cancer rather than primary cancer. About 80% of CCAs are ECCs, of which Klatskin's tumors and distal cholangiocarcinomas account for 50–60% and 20–25%, respectively [2].

Radical resection is still the only curative treatment for this disease. With the development of surgical techniques and perioperative management in recent years, there are several extended resection procedures that have proceeded successfully for cases of advanced hilar cholangiocarcinoma. They are hepatic right/left trisectionectomy for

* Corresponding author at: Department of Surgeon, Hanoi Medical University, No 40 Trang Thi Street, Hanoi, Viet Nam.

E-mail address: hiep1995hsgs@gmail.com (T.H. Luong).

¹ Contributed equally to this work as co-first authors.

Abbreviations

ALPPS	Associating liver partition and portal vein ligation for staged hepatectomy
CCA	Cholangiocarcinoma
ECC	Extra-hepatic cholangiocarcinoma
CT	Computed tomography
GI	Gastrointestinal
HCC	Hepatocellular carcinoma
PV	Portal vein

Bismuth type IV tumors, hepato-pancreaticoduodenectomy (HPD) for tumors with extensive longitudinal spreading and/or combined vascular resection for tumors involving adjacent vascular structures [3]. And to improve the R0-resection rate and avoid the local recurrence, the “non-touch technique” principal was discovered. However, these procedures are still challenging for all Hepato-pancreato-biliary surgeons, especially in developing countries. In our knowledge, there have been not an article with describing the hepatic right trisectionectomy combined total caudate lobectomy step-by-steps with clearly illustrated video and figures that was published yet. Herein, we reported a surgical case report of advanced hilar cholangiocarcinoma while was treated successful with the hepatic right trisectionectomy combined total caudate lobectomy with “non-touch technique”. All our work has been reported in line with the SCARE criteria and guidelines [4].

2. Case presentation

A 45-year-old female was admitted to hospital with obstructive jaundice and the hilar CCA was found. At the time of finding CCA, enhanced computed tomography showed the widely extension and involved the right intrahepatic bile ducts in continuity with the left medial sectional bile duct without portal veins (PV) invasion. And the rate of liver volume remnant, equivalent to volume of subsegment 2 and 3, was 24,5% (Fig. 1). According to extension of CCA, right tri-segmentectomy combined with total caudate lobectomy with non-touch technique was scheduled.

A laparotomy was performed through an upper j-shaped incision with right lateral subcostal extensions. Isolated resection of the hepatoduodenal ligament, including dissection of the hilar and surrounding lymph nodes (LNs number 12a,b,p; 7,8,9 following Japanese lymph node stations pancreatic cancer [5]). Dissection of the gallbladder.

Dissection of the hepatic peduncle by Lorta-Jacob Procedure [6], ligation, and resection of the right hepatic artery (RHA). Dissection and ligation of the right portal vein (PV) outside the hepatic parenchyma, then the stump was closed with a continuous suture. Determine whether portal bifurcation's tumor infiltration or not, isolate the portal bifurcation from the tumor during resection of the hepatoduodenal ligament. Resection of the common bile duct (CBD) just above the anterior side of pancreas, determine the lower section of CBD with immediate biopsy (Video 1).

Mobilization of the right liver lobe, ligate all the short hepatic veins from the caudal to cranial direction, as well as the right hepatic vein



Fig. 1. The computed tomography result showed a tumor with a the widely extension and involved the right intrahepatic bile ducts in continuity with the left medial sectional bile duct without portal veins (PV) invasion. The rate of liver volume remnant, equivalent to volume of subsegment 2 and 3, was 24,5%.

(RHV) and the middle hepatic vein (MHV) with two Surgical Stapler™ 45 mm. The right-side of caudate pedicle often comes from the posterior right hepatic pedicle (usually about 1 cm from the posterior segmental pedicle), which were resected contemporary with other right hepatic pedicle elements. With left-side approach, often after opening of the lesser omentum, caudate lobe is pushed posteriorly to the Arantius fascia to show its pedicle, usually there are two pedicles enter caudate lobe from the left hepatic pedicle, as well as ligate the entire veins into this part up to the left hepatic vein (LHV), then tie the vein into the caudate process. Due to the caudate lobe was to be resected totally, all vena caval tributaries except the left hepatic veins were ligated.

Determine hepatic parenchyma cut, then resect vascular branches, biliary tract with Monosyl™, Bipolar™ and LigaSure™. Left choangiostomy to the division of the subsegment 2,3, the liver parenchyma is resected just below the Arantius' ligament, separating the liver parenchyma from the inferior surface of the middle and left HVs. Determine negative upper section of the biliary tract with immediate biopsies (Video 2). During the entire dissection, we didn't touch the tumor, so that, the tumor was totally resected with a wide tumor-free resection margins and the avoidance of dissection near tumor tissue ("non-touch technique" principle).

Stitch formation of the subsegment 2,3 bile duct; Resection of the lower jejunum distal from Trietz's junction 20 cm with 01 Surgical Stapler™ 80 mm. Bilioenteric continuity with Roux-en-Y hepaticojejunostomy style, with a mucosa-to-mucosa alignment, by interrupted sutures using 5-0 polydioxanone and a total alignment by continuous sutures using 5-0 polydioxanone (Fig. 2). We have decided to restore a percutaneous transhepatic biliary drainage to avoid post-hepatectomy bile leakage. The tube was usually removed 3 weeks after hepatectomy.

Liver resection was performed safely without any intraoperative complications. The operative time was 432 min, and the blood loss was 750 ml. Serum alanine transaminase and aspartate transaminase levels were moderately (<500 U/L) elevated after hepatectomy, followed by a return to normal range within 1 week. Insufficiency of hepaticojejunostomy did not occur in the patient. Postoperative recovery

was uneventful without any major complications but developed intra-abdominal abscess that required percutaneous drainage. The patient was discharged from the hospital in good condition after 19 post-operative days.

Histologically, the patient was diagnosed as having invasive type cholangiocarcinoma with hepatic parenchymal permeation and perineural invasion but no lymph nodes metastasis (pT3N0Mx according to The American Joint Committee on Cancer (AJCC) 8th Staging [7]). Proximal and distal resection margin were negative.

3. Discussion

Hilar cholangiocarcinoma, which was described firstly by Klatskin in 1965, accounted for about 50% of cholangiocarcinomas [8]. In definition, extrahepatic cholangiocarcinoma is cancer that originates from the biliary epithelium and occurs at any site of the extrahepatic bile duct. It is divided into cholangiocarcinoma (Klatskin's tumor) and distal ductal carcinoma. Klatskin's tumors include those located within 2 cm of the bifurcation of the common hepatic duct [9]. There are many risk factors leading to ECC, of which three high risk factors are congenital biliary dilatation, gallstone infection of the biliary tract and primary sclerosing cholangitis [10]. The common mechanism causing ECC is stagnation of bile, reflux of pancreatic fluid into the biliary tract and cholangitis, which can change the structure of the biliary epithelium. Especially, in 98% of ECC patients have gall bladder stones, and 1 out of every 100 patients with gall bladder stones may develop ECC [10]. In epidemiology, CCA is more common in elderly patients and is more common in men than in women. According to German authors, the mean age of CCA is 54.2 ± 11.3 years old and is more common in men than women with an approximate ratio of 1.4. [11]. Otherwise, Japanese authors studying hilar CCA found that the middle age of these group of patients was 62.0 years old, and the male/female ratio was about 1.5 [12]. The Hong Kong authors found that intrahepatic CCA (ICC) had an average age of 61.8 years and a male/female ratio of approximately 1.5 [13].

Advanced hilar CCA can be defined as tumors with upward or downward extensive longitudinal spreading and/or combined major

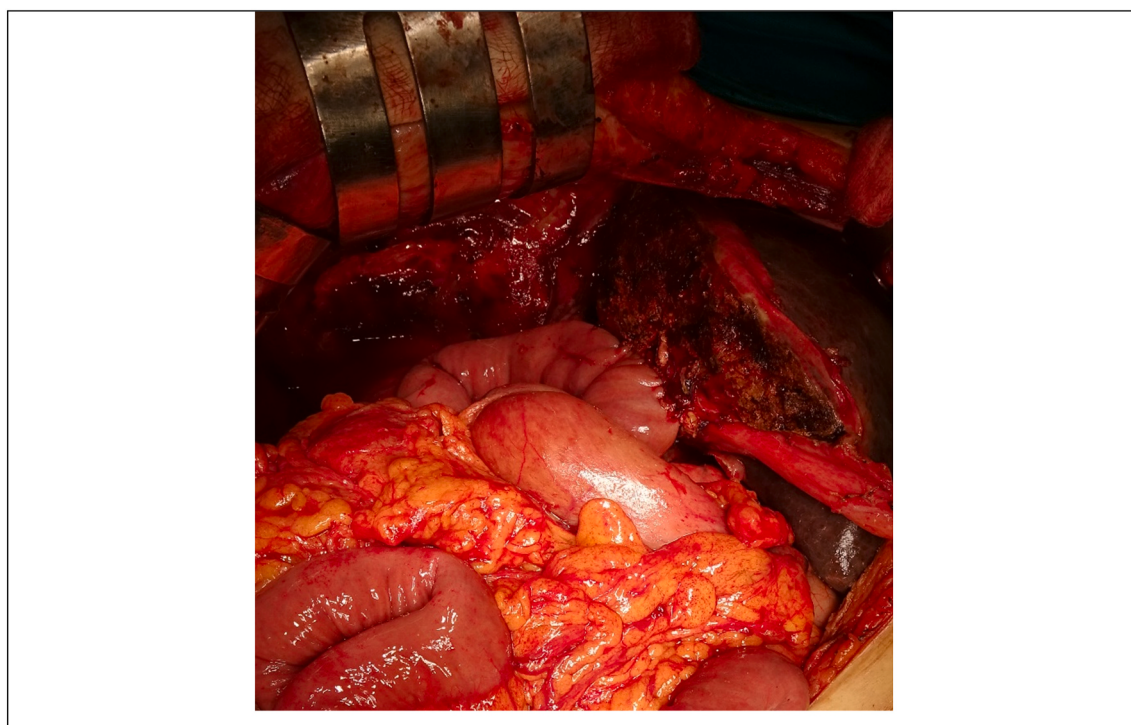


Fig. 2. Bilioenteric continuity with Roux-en-Y hepaticojejunostomy style.

vascular invasion. Advanced hilar CCA with upward extensive longitudinal spreading, which is defined as a Bismuth type IV tumor according to The Bismuth classification system, is a hilar cholangiocarcinoma with bilateral involvement of second-order biliary radicles [14]. In the recent 8th edition of the American Joint Committee on Cancer (AJCC) cancer staging manual, Bismuth type IV tumor hasn't classified as the T4 category anymore, which can be understood that these Bismuth type IV tumors are no longer contraindications for resection [7]. And the favored aggressive surgical approach for Bismuth type IV tumors was right/left trisectionectomy, which was proved more advantageous than hemihepatectomy in oncological aspects (increased R0-proximal ductal margin) [15,16]. Right hepatic trisectionectomy, which was called extended right hepatectomy/ right hepatic lobectomy in European countries, was firstly reported by Lortat-Jacob et al. in 1952 and technically completed by Starzl et al. in 1975 [6,17]. This technique was standardized and widely applicable to hepatocellular carcinoma, liver metastasis, and benign hepatic diseases, but still has limited applications in field of hilar cholangiocarcinoma, which was required more novel techniques to achieve negative resection margins on the intrahepatic bile ducts [18].

The surgical term “non-touch technique”, which was first introduced by Neuhaus et al. in 1999, was based on the oncological principle of minimal R0-resection margins and avoid of disrupted tumor [19]. This term was quite similar with en bloc resection of extrahepatic bile duct, right hepatic artery (RHA), and six liver segments 1 and 6 to 8. Portal vein bifurcation resection previously was recommended in en bloc resection, with evidence of improved rate of negative margins [20,21]. However, due to no difference in long-term survival was found in group of portal vein resection versus group that did not as well as increased perioperative morbidity, this procedure should be considered carefully and proceeded with experienced surgeons in high-volume centers, and may be avoid if the tumor could be detached firmly with the portal vein bifurcation [21].

Extended right hepatic trisectionectomy, or “Anatomic” Right Hepatic Trisectionectomy, is a combined technique of right hepatic trisectionectomy and total caudate lobectomy, which include resection of hepatic subsegments 1, 4, 5, 6, 7, and 8 according to the Couinaud classification [22]. This procedure is mainly indicated for advanced hilar CCA with tumoral involvement of the right intrahepatic bile ducts in continuity with the left medial sectional bile duct, so that, comparing the classic right hepatic trisectionectomy, it is a completely different, due to the proximal bile duct is cut at the confluence of the bile ducts from subsegments 2 and 3, which was at the left side of the umbilical portion of the left PV [18]. Due to the biliary tributaries of the caudate lobe directly arise from the bile duct bifurcation, resection of the caudate lobe was recommended, especially with tumor around caudate lobe area [23]. This liver resection is very extensive, due to the average relative volume was accounted for about 81% of total liver volume [24]. So that, in most cases, authors have chosen several approaches to increase liver volume remnant and avoid risks of post-hepatectomy liver failure, such as right and segment 4 portal vein embolization, the associating liver partition and PV ligation for staged hepatectomy (ALPPS) procedure [3].

In addition, to minimize the risks of post-hepatectomy liver failure, meticulous perioperative management as well as precise evaluation of the functional capacity of the future liver remnant are very important points. Some radiological interventions have been widely accepted to reduce risks of post-hepatectomy liver failure include Preoperative biliary drainage methods (percutaneous transhepatic biliary drainage, endoscopic nasobiliary drainage and endoscopic biliary stenting), Portal vein embolization to increase liver volume remnant. In our case, our patient was proceeded percutaneous transhepatic biliary drainage 3 weeks preoperatively, and the level of total and direct Bilirubin were 50 $\mu\text{mol/l}$ and 43,6 $\mu\text{mol/l}$ (normal ranges were less than 17,1 and 5,1 $\mu\text{mol/l}$, respectively). And the rate of liver volume remnant, equivalent to volume of subsegment 2 and 3, was 24,5% (Fig. 1). These meticulous

operative preparations were key points for avoid post-hepatectomy liver failure.

4. Conclusion

Extended resection procedures such as extend right/left trisectionectomy, hepato-pancreaticoduodenectomy (HPD) and/or combined vascular resection for advanced hilar cholangiocarcinoma are still challenging for all Hepato-pancreato-biliary surgeons, especially in developing countries like Vietnam. And “non-touch technique” principal was becoming standard surgical step to reduce local recurrence. Careful preparation with preoperative biliary drainage as well as precise evaluation of the functional capacity of the future liver remnant, as well as meticulous experience of surgeons in hepatic anatomy and resection techniques are key points for success.

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ijscr.2022.106987>.

Ethics approval and consent to participate

Ethics approval of this study was given by the Research Ethics Committees of Bach Mai Hospital. Authors have agreed to submit it in its current form for consideration for publication in the Journal.

Consent for publication

Written informed consent for publication of their clinical details and clinical images was obtained from the patient's next of kin.

Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Funding

The authors declare no funding for this study.

Guarantor

Thanh Khiem Nguyen

CRediT authorship contribution statement

TKN: the main doctor conceived the original idea and operated the patients, edited manuscript; HHN: the main doctor conceived the original idea and operated the patients, edited manuscript [1–24]; THL: followed up the patients, wrote manuscript, designed technical videos and figures; VKL: provided diagnostic imagines, summed up, revised manuscript; KKD: operated the patients, designed technical videos and figures; VDL: operated the patients, summed up, revised manuscript. All authors contributed to the interpretation of the results, discussed the results. All authors read and approved the final manuscript to submit.

Declaration of competing interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Acknowledgements

The authors wish to thank the board of the Department of Gastro-intestinal and Hepato-pancreato-biliary surgery, Bach Mai Hospital, Hanoi, Vietnam for their assistance during the time in-hospital observation of this patient.

References

- [1] J.M. Banales, J.J.G. Marin, A. Lamarca, P.M. Rodrigues, S.A. Khan, L.R. Roberts, V. Cardinale, G. Carpino, J.B. Andersen, C. Braconi, et al., Cholangiocarcinoma 2020: the next horizon in mechanisms and management, *Nat. Rev. Gastroenterol. Hepatol.* 17 (9) (2020) 557–588.
- [2] P. Gavrilidis, A. Askari, K.J. Roberts, R.P. Sutcliffe, Appraisal of the current guidelines for management of cholangiocarcinoma-using the appraisal of guidelines research and evaluation II (AGREE II) instrument, *Hepatobiliary Surg. Nutr.* 9 (2) (2020) 126–135.
- [3] T. Mizuno, T. Ebata, M. Nagino, Advanced hilar cholangiocarcinoma: an aggressive surgical approach for the treatment of advanced hilar cholangiocarcinoma: perioperative management, extended procedures, and multidisciplinary approaches, *Surg. Oncol.* 33 (2020) 201–206.
- [4] R.A. Agha, T. Franchi, C. Sohrabi, G. Mathew, A. Kerwan, The SCARE 2020 guideline: updating consensus surgical Case REport (SCARE) guidelines, *Int. J. Surg.* 84 (2020) 226–230.
- [5] S. Isaji, Y. Murata, M. Kishiwada, New Japanese classification of pancreatic cancer, in: J.P. Neoptolemos, R. Urrutia, J.L. Abbruzzese, M.W. Büchler (Eds.), *Pancreatic Cancer*, Springer New York, New York, NY, 2018, pp. 1021–1037.
- [6] J.L. Lortat-Jacob, H.G. Robert, C. Henry, Excision of the right lobe of the liver for a malignant secondary tumor, *Arch. Mal. Appar. Dig. Mal. Nutr.* 41 (6) (1952) 662–667.
- [7] M. Amin, S. Edge, ES, F. Greene, *AJCC Cancer Staging Manual*, Springer, Chicago, IL, 2017.
- [8] T.P. Kingham, V.G. Aveson, A.C. Wei, J.A. Castellanos, P.J. Allen, D.P. Nussbaum, Y. Hu, M.I. D'Angelica, Surgical management of biliary malignancy, *Curr. Probl. Surg.* 58 (2) (2021), 100854.
- [9] N.F. Esnaola, J.E. Meyer, A. Karachristos, J.L. Maranki, E.R. Camp, C.S. Denlinger, Evaluation and management of intrahepatic and extrahepatic cholangiocarcinoma, *Cancer* 122 (9) (2016) 1349–1369.
- [10] S.A. Khan, S. Tavolari, G. Brandi, Cholangiocarcinoma: epidemiology and risk factors, *Liver Int.* 39 (Suppl. 1) (2019) 19–31.
- [11] A.S. Khan, L.A. Dageforde, Cholangiocarcinoma, *Surg. Clin. North Am.* 99 (2) (2019) 315–335.
- [12] R.S. Chamberlain, L.H. Blumgart, Hilar cholangiocarcinoma: a review and commentary, *Ann. Surg. Oncol.* 7 (1) (2000) 55–66.
- [13] K.M. Chu, S.T. Fan, Intrahepatic cholangiocarcinoma in Hong Kong, *J. Hepato-Biliary-Pancreat. Surg.* 6 (2) (1999) 149–153.
- [14] H. Bismuth, R. Nakache, T.O.M. Diamond, Management strategies in resection for hilar cholangiocarcinoma, *Ann. Surg.* 215 (1) (1992).
- [15] N. Matsumoto, T. Ebata, Y. Yokoyama, T. Igami, G. Sugawara, Y. Shimoyama, M. Nagino, Role of anatomical right hepatic trisectionectomy for perihilar cholangiocarcinoma, *Br. J. Surg.* 101 (3) (2014) 261–268.
- [16] S. Natsume, T. Ebata, Y. Yokoyama, T. Igami, G. Sugawara, Y. Shimoyama, M. Nagino, Clinical significance of left trisectionectomy for perihilar cholangiocarcinoma: an appraisal and comparison with left hepatectomy, *Ann. Surg.* 255 (4) (2012) 754–762.
- [17] T.E. Starzl, R.H. Bell, R.W. Beart, C.W. Putnam, Hepatic trisegmentectomy and other liver resections, *Surg Gynecol Obstet* 141 (3) (1975) 429–437.
- [18] M. Nagino, J. Kamiya, T. Arai, H. Nishio, T. Ebata, Y. Nimura, "Anatomic" right hepatic trisectionectomy (extended right hepatectomy) with caudate lobectomy for hilar cholangiocarcinoma, *Ann. Surg.* 243 (1) (2006) 28–32.
- [19] P. Neuhaus, S. Jonas, W.O. Bechstein, R. Lohmann, C. Radke, N. Kling, C. Wex, H. Lobeck, R. Hintze, Extended resections for hilar cholangiocarcinoma, *Ann. Surg.* 230 (6) (1999) 808–818, discussion 819.
- [20] P. Neuhaus, A. Thelen, Radical surgery for right-sided klatskin tumor, *HPB (Oxford)* 10 (3) (2008) 171–173.
- [21] A.W. Hemming, K. Mekeel, A. Khanna, A. Baquerizo, R.D. Kim, Portal vein resection in management of hilar cholangiocarcinoma, *J. Am. Coll. Surg.* 212 (4) (2011) 604–613, discussion 613–606.
- [22] S.M. Strasberg, J. Belghiti, P.A. Clavien, E. Gadzijev, J.O. Garden, W.Y. Lau, M. Makuuchi, R.W. Strong, The Brisbane 2000 terminology of liver anatomy and resections, *HPB* 2 (3) (2000) 333–339.
- [23] R. Mizumoto, H. Suzuki, Surgical anatomy of the hepatic hilum with special reference to the caudate lobe, *World J. Surg.* 12 (1) (1988) 2–10.
- [24] M. Nagino, Y. Nimura, J. Kamiya, S. Kondo, K. Uesaka, Y. Kin, Y. Kutsuna, N. Hayakawa, H. Yamamoto, Right or left trisegment portal vein embolization before hepatic trisegmentectomy for hilar bile duct carcinoma, *Surgery* 117 (6) (1995) 677–681.